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Challenges in Developing and Fielding an Interoperable Vehicle Health and Diagnostics System

Robert Hess
Diagnostics Systems Lead
Goodrich Corporation
Robert.Hess@Goodrich.com
Vergennes, Vermont

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IMD HUMS

- Integrated Mechanical Diagnostics Health & Usage Management System
- Condition-Based Maintenance System
  - Current Applications on Rotary Wing Aircraft
    - SH-60B / UH-60A / UH-60L
    - AH-1Z / UH-1Y
    - CH-53E
    - S-92
- Designed for Interoperability
  - Common Parts (HW & SW)
- Open System (Allows 3rd Party HW & SW)

Interoperability

- **Navy IMD HUMS ORD:**

  "Joint Service procurement and support strategies shall be pursued to reduce costs and duplicative efforts. The IMD system shall be easily adapted to multiple helicopter platforms. The system must comply with applicable information technology standards contained in the DOD Joint Technical Architecture (JTA)."

- **Army JTA Definition:**

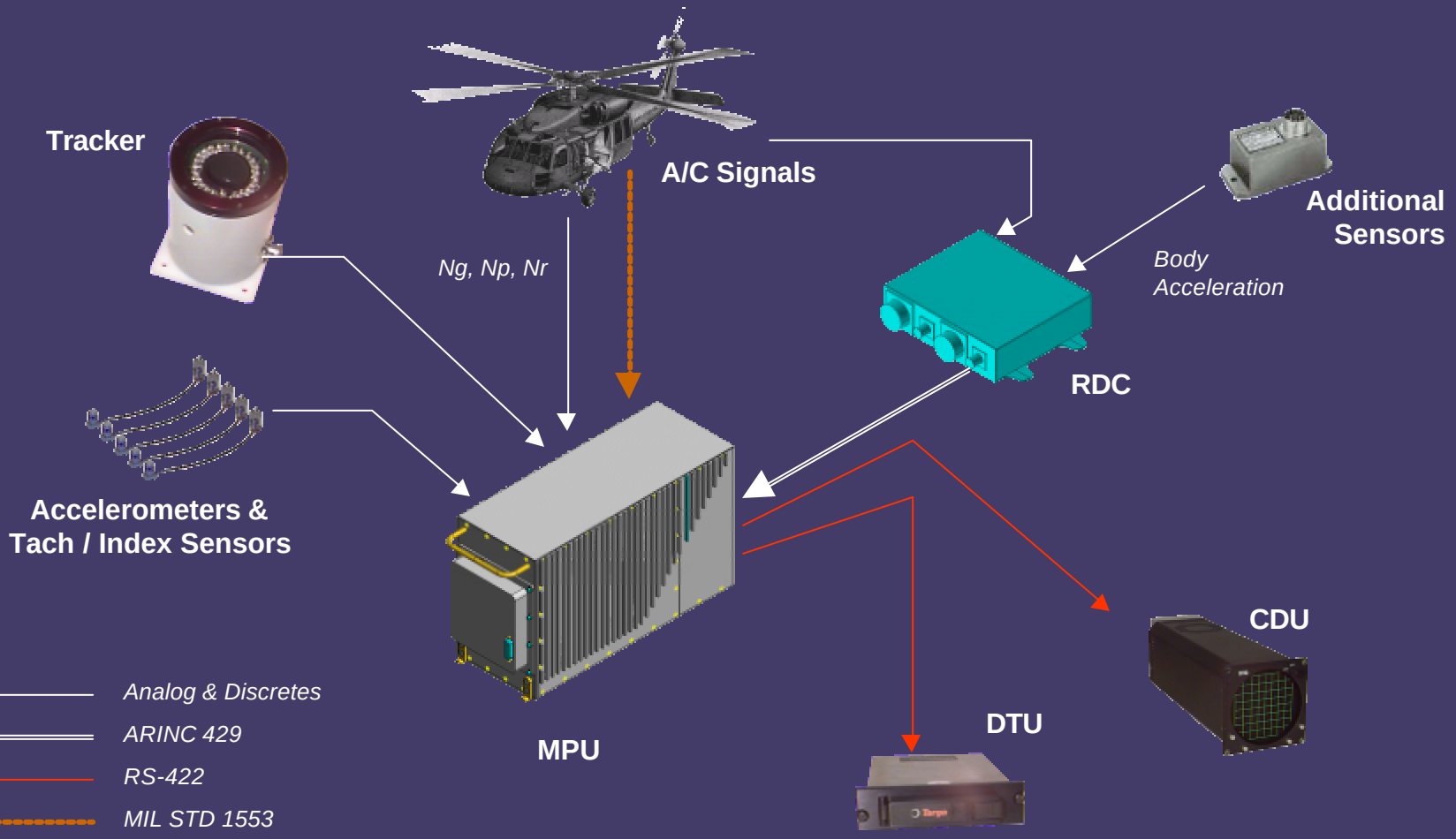
  "The ability of two or more systems or components to exchange data and use information. (IEEE STD 610.12)"

  "The ability of two or more systems to exchange information and to mutually use the information that has been exchanged. (Army Science Board)"

Interoperable Elements

- **Adaptability to Multiple Aircraft**
  - **Common HW**
  - **Common SW**
  - **Cross Platform**
  - **Cross User**
- **Use & Exchange Information Between Systems**
  - **Established Interfaces**
  - **Common Reporting**
  - **Common Data**

System Block Diagram



Data Flow

Exceedances
Events
Operation Usage
Structural Usage
Operational Regimes
Onboard System Faults
Signal Data
Computed Data
Exceptional Condition Indicators
Health Indicators
Rotor Track and Balance Data

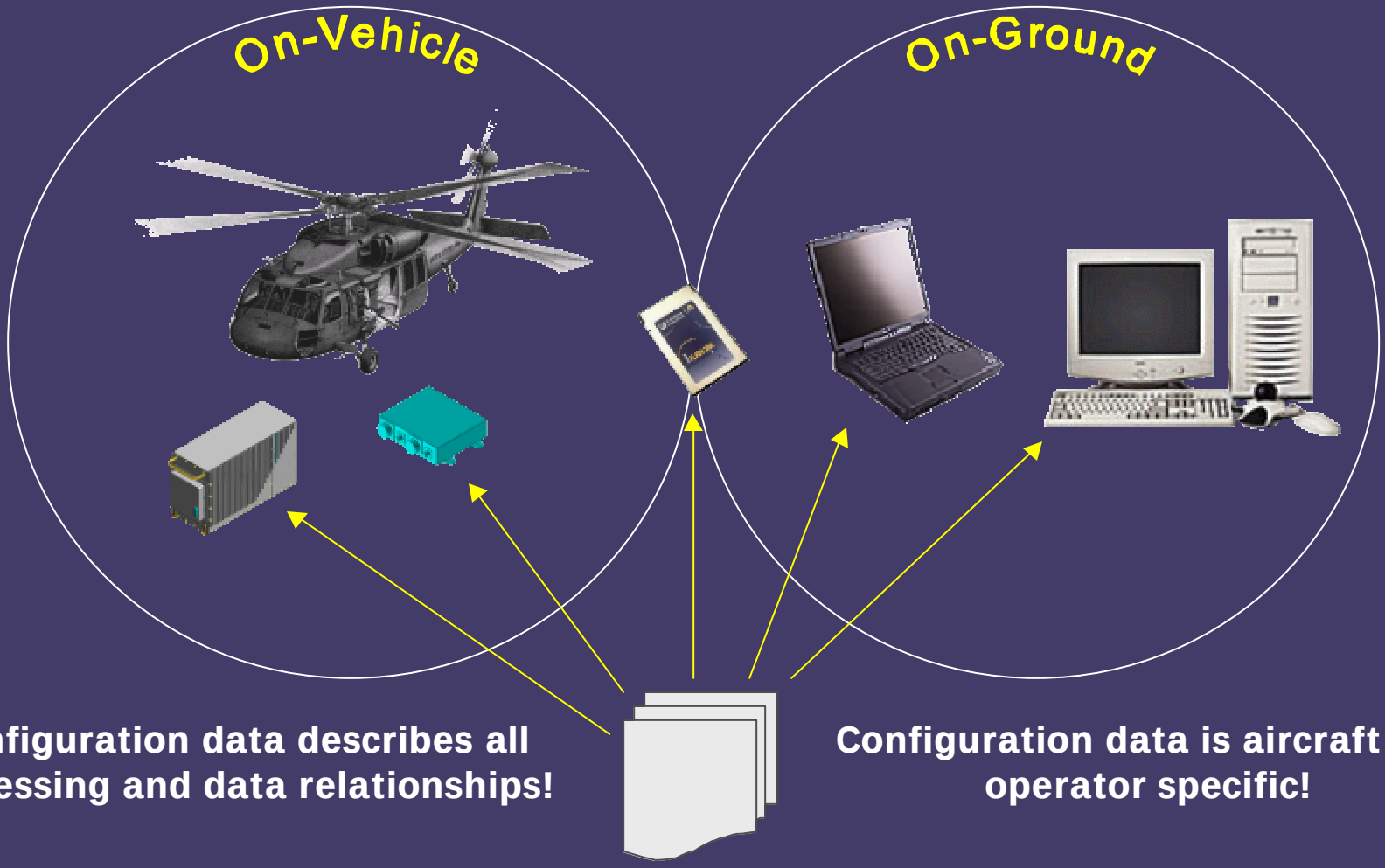
CREW
- Auto. & Prompted Procedures
- Advisories
- Vibration Monitoring
- RTB Operations
- Exceedance Monitoring
- Power Assurance
- Data Logging
- Usage
- BIT

MAINTAINER
- Debrief
- MAF Generation
- Diagnostics
- Troubleshooting
- Part Usage / Lifeing
- Part Tracking

ENGINEERING
- Data Plotting
- Trending
- Diagnostics

PLATFORM MANAGER
- Readiness
- Logistics Support Data

Configurable Design



Configuration data describes all processing and data relationships!

Configuration data is aircraft and operator specific!

Configuration Data

- On-Vehicle Processing
- Activity Data Files
- IMD Groundstation

- I/O, procedures, data logging, thresholds
- Contents, parameter definitions, data packet descriptions
- IMD maintenance, maintenance action, parts life calculations, reporting

Interoperability Enablers

- Commonality of Hardware
  - Dual-use, military & commercial qualification & interfaces
- Commonality of Software
  - Dual-use, military & commercial
  - DO-178B standards for development
- Open Interfaces
  - Published interfaces for data on PC Card
- Field Programmable

Interoperability Detractors

- Customer Business Rules
  - Different Processes / Procedures
  - Differing External Systems / Information Systems
  - Differing Maintenance Practices
- Access to Configuration & Historical Data
  - Limits maintenance and logistics management functionality

Concept of Operations

- A memory card can be read into any ground station at any location. The resulting data file may be transmitted to the “owning” unit where the historical data for the aircraft is stored.
- At a "foreign" location, only a limited view of information is possible (lack of historical and aircraft configuration). Ground crew can review operation exceedances
- “Owning” unit can review trend, scheduled maintenance, equipment configuration, historical data

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Software Componentization

- Software Commonality versus Civil Certification
  - Civil certification forces unused code to be removed
  - Componentization of software for on-board software
  - Not all software may be the same!
- Groundstation software supports all functionality
  - Drives increased regression testing
  - Carefully plan integration of functionality

Interoperability Assessment

. . . Data from a different model helicopter can be examined but not processed. In this case, the data file would have to be transferred to the supporting ground station for processing and analyses.

. . . The ground station software used in all applications is identical, but it must be configured to support a particular model helicopter. Data from a different model helicopter can be downloaded and read by any ground station, but the supporting ground station can only perform diagnostic and high fidelity rotor track and balance functions.

. . . (An) aircraft experiencing problems while operating away from its home station can download its data to any civil ground station available which can then transmit the data to the aircraft's supporting ground station. The supporting ground station could then analyze the data and recommend the necessary actions to allow the aircraft to continue its' mission. . . .

General Assessment

On-Vehicle		ADF		Groundstation		Operator MMIS	
Common HW	●	Established	●	Common SW	●	Cross Platform	●
Common SW	●	Interfaces		Cross Platform	●	Cross User	●
Cross Platform	●			Cross User	●	Common Reporting	●
Cross User	●			Common Data	●	Common Data	●

Concluding Remarks

- IMD HUMS diagnostic system provides effective interoperability for on-vehicle and IMD-specific on-ground processing
- Dual-use application can limit commonality
- Major areas where interoperability is compromised include cross-user operations and data sharing across differing user maintenance and logistic systems